Office of the President
University of Maryland, Baltimore County
1000 Hilltop Circle, Baltimore, MD 21250

Phone: 410-455-2274
Fax: 410-455-1210

June 07, 2021

James D. Fielder, Jr. Ph.D.

Maryland Higher Education Commission

6 North Liberty Street

Baltimore, MD 21201

Dear Secretary Fielder:

UMBC proposes to offer the upper division of its outstanding Bachelor of Science in Mechanical Engineering at the Universities at Shady Grove. This is a high demand employment field, and the UMBC program is taught by high caliber faculty. We are delighted to offer this opportunity to students in Montgomery County.

I am immensely pleased that USM has committed funds from its USM Workforce Development Initiative (WDI) to offer this program at Universities of Shady Grove.

Thank you very much for your review of the program.

Sincerely,

Freeman A. Hrabowski

Freeman A. Hrabowski, III
President

C: Dr. Antonio Moreira

Beth Wells

Office Use Only: PP#

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	UMBC

Each action below requires a separate proposal and cover sheet.

- ○ New Academic Program
- ○ New Area of Concentration
- ○ New Degree Level Approval
- ○ New Stand-Alone Certificate
- ○ Off Campus Program
- ○ Substantial Change to a Degree Program
- ○ Substantial Change to an Area of Concentration
- ○ Substantial Change to a Certificate Program
- ○ Cooperative Degree Program
- ◉ Offer Program at Regional Higher Education Center

Payment Submitted: ○ Yes ◉ No Payment Type: ○ R*STARS # ○ Check # Payment Amount: $0.00 Date Submitted:

Department Proposing Program	Mechanical Engineering	
Degree Level and Degree Type	B. S.	
Title of Proposed Program	Mechanical Engineering	
Total Number of Credits	127	
Suggested Codes	HEGIS: 91000.00	CIP: 14.1901
Program Modality	◉ On-campus	○ Distance Education (*fully online*)
Program Resources	◉ Using Existing Resources	○ Requiring New Resources
Projected Implementation Date	◉ Fall ○ Spring ○ Summer	Year: 2022
Provide Link to Most Recent Academic Catalog	URL: https://me.umbc.edu/	
Preferred Contact for this Proposal	Name: Beth Wells	
	Title: Director of Academic Administration	
	Phone: (410) 274-8660	
	Email: bwells@umbc.edu	
President/Chief Executive	Type Name: Freeman A. Hrabowski, III	
	Signature: Freeman A. Hrabowski	Date: June 3, 2021
	Date of Approval/Endorsement by Governing Board:	

Revised 1/2021

UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR

	New Instructional Program
X	Substantial Expansion/Major Modification
	Cooperative Degree Program
	Within Existing Resources, or
	Requiring New Resources

UMBC

Institution Submitting Proposal

Mechanical Engineering at USG

Title of Proposed Program

B. S.	**Fall 2022**
Award to be Offered	Projected Implementation Date
091000	**14.1901**
Proposed HEGIS Code	Proposed CIP Code
Mechanical Engineering	Beth Wells
Department in which program will be located	Department Contact
410-274-8660	bwells@umbc.edu
Contact Phone Number	Contact E-Mail Address
Freeman A. Hrabowski	June 3, 2021
Signature of President or Designee	Date

Maryland Higher Education Commission (MHEC)

Academic Program Proposal to Offer Existing Bachelor's Degree in Mechanical Engineering at the Universities at Shady Grove

UMBC

A. Centrality to Institutional Mission and Planning Priorities: Offering the upper division of UMBC's current Bachelor of Science Degree in Mechanical Engineering (ME) at the Universities at Shady Grove (USG) campus in Montgomery County is consistent with UMBC's mission statement. Specifically, the mission statement references the commitment to "contribute to the economic development of the State and the region". Currently, there are no universities that offer a B.S. in Mechanical Engineering at USG. Expanding this program to the Montgomery County campus will provide affordable educational opportunities to the residents of Montgomery County and support the state economy by graduating qualified engineering professionals. Montgomery County is home to the National Institute of Standards and Technology and the National Institutes for Health and private sector companies such as Lockheed Martin and BAE Systems, all of which employ Mechanical Engineers.

The Community and Extended Connections section of the UMBC strategic plan: A Strategic Plan for Advancing Excellence specifically highlights a strategic objective to "continue to address novel and important professional development and continuing education needs in Maryland through courses, programs, and services provided by the Division of Professional Studies (DPS)…including UMBC programs offered at Shady Grove." Growing UMBC's presence at USG also contributes to one of the Community and Extended Connections strategic goals to "advance UMBC's regional reputation as a vital stakeholder in Maryland's innovation economy."

UMBC is committed to supporting this program administratively, financially, and technically. The source of funds includes both tuition revenue and funding from the University System of Maryland (USM). UMBC has been offering programs at USG since 2001 and the infrastructure to support new programs is already in place. UMBC at Shady Grove has administrative offices and access to classroom space, as well as an administrative staff of five.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan: Offering the B.S. in Mechanical Engineering responds to crucial state needs as identified in the Maryland State Plan for Postsecondary Education (2017 - 2021). One of the overarching themes of the plan is increasing access to higher education. Specifically, the plan references a goal to, "Ensure equitable access to affordable

and quality postsecondary education for all Maryland residents." One of USG's core values is to expand access to higher education by providing programs to Montgomery County residents who for family, personal, or financial reasons want to stay in Montgomery County to earn their degree. According to the USG Research and Data Office, 75% of USG undergraduate students transfer from Montgomery College. Additionally, both USG and Montgomery College are majority-minority campuses. As of Fall 2017, 77.2% of the 22,875 students attending Montgomery College identify as a race other than white.[1] At USG, 67% of the student body identifies as a race other than white.[2] Currently, there is no way for a student to earn a B.S. in Mechanical Engineering in Montgomery County, thus limiting their access to this program. The B.S. in Mechanical Engineering is a large and in-demand major at UMBC. It is a highly respected program with over 600 enrolled undergraduate students on the main campus. The number of B.S. degrees awarded has increased steadily since 2000 and surpassed 100 the past three years.

The USM Through 2020: A Renewed Vision for Powering Maryland Forward, an update to USM's 10-year Strategic Plan, also supports the expansion of the B.S. in Mechanical Engineering to a racially diverse campus like USG. The first three goals listed in the new and revised plan are:

- Increase the number of bachelor's degrees awarded to underrepresented minority students by 900.
- Expand bachelor's degrees earned annually by underrepresented minority students in STEM and health fields by 14% and 50% (to over 1,800 and 1,000 respectively).
- Increase the number of underrepresented minority students, faculty, and staff studying, working, and/or teaching at USM institutions.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State: Mechanical Engineers are in high-demand in the Washington-Baltimore metropolitan region. The Bureau of Labor Statistics projects that the labor market demand for mechanical engineers will continue to remain strong. In particular, Mechanical Engineers who have skills in computational design and simulation will have strong job prospects.[3]

According to O*NET, an occupational information database sponsored by the U.S. Department of Labor, the number of job openings for Mechanical Engineering in Maryland is expected to increase by 4%

[1] https://www.montgomerycollege.edu/_documents/offices/institutional-research-and-effectiveness/student-enrollment-profile-and-fact-book.pdf
[2] https://shadygrove.umd.edu/sites/default/files/u80/USG%20At%20A%20Glance%20-%20Executive%20Flyer.pdf
[3] Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Mechanical Engineers, https://www.bls.gov/ooh/architecture-and-engineering/mechanical-engineers.htm

during the period 2016 – 2026.[4] Additionally, in Fall 2018, 20% of the incoming Freshman and 19% of the transfer students in UMBC's Mechanical Engineering program were residents of Montgomery County. There is a significant pipeline of students from Montgomery County interested in UMBC's B.S. in Mechanical Engineering. We anticipate that the bulk of the enrollment at USG will be students who otherwise would not have the opportunity to study Mechanical Engineering close to their home, thus increasing the total number of Mechanical Engineering majors graduating from UMBC.

Montgomery County is home to both companies and large organizations such as the National Institute of Standards and Technology, the National Institutes of Health, and the National Oceanographic and Atmospheric Administration. The labor market for Mechanical Engineering professionals in the Washington DC area has a 30% higher demand than the national average.[5]

The target audience will be community college and other transfer students who have completed coursework or an Associate of Science (A.S) degree in Engineering. Due to the location of USG, Montgomery College (MC) is likely to be the largest feeder of students. MC offers an A.S. degree in Engineering. There are 11 engineering specializations within the degree, including Mechanical.

D. Reasonableness of Program Duplication: A search of the IPEDS College Navigator and other university websites found one other Bachelor of Science in Mechanical Engineering programs in the greater Washington DC metro area of Maryland.

Institution	**Program Title**	**Location**	**Full Time Program Tuition per year as of Fall 2019**
University of Maryland, College Park	Bachelor of Science in Mechanical Engineering	College Park	$11,680*(Maryland resident)

***Full-time juniors and seniors majoring in Engineering pay a differential tuition rate of $2,856 per year on top of the $8,824 per year Maryland resident tuition.**

[4] https://www.onetonline.org/

[5] Source: Burning Glass Technologies. http://www.burning-glass.com. 2018.

The University of Maryland, College Park (UMCP) program is not offered at USG or in Montgomery County. As of Fall 2019, full-time tuition per year for a student in a UMBC program at USG is $8,704 per year vs. $11,680 per year for a junior or senior Engineering student at UMCP. UMBC offering a B.S. in Mechanical Engineering at USG provides an option to students who need or want to complete their degree in Montgomery County due to financial, personal, or family reasons.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs): Of the four HBIs in Maryland (Bowie State University, Morgan State University, Coppin State University, University of Maryland, Eastern Shore), only University of Maryland, Eastern Shore (UMES) offers a similar program; a General Engineering degree with a specialization in Mechanical. Offering the existing Mechanical Engineering program at USG should have minimal impact on enrollment at UMES, as the USG program in Montgomery College is unlikely to compete with one on the Eastern Shore.

F. Relevance to the support of the uniqueness and identity of Historically Black Institutions (HBIs)
Offering UMBC's program at USG should have no impact on the uniqueness and institutional identities and mission of the HBIs. Bowie State University and Coppin State University do not offer programs in Engineering; Morgan State University does not offer a program in Mechanical Engineering; and UMES offers a General Engineering degree with a specialization in Mechanical. What is proposed here is to offer UMBC's existing B.S. in Mechanical Engineering at USG.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes: UMBC's Mechanical Engineering program is housed in the College of Engineering and Information Technology (COEIT)'s Department of Mechanical Engineering (ME). The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

At USG, ME will offer upper-division (300 and 400 level) Mechanical Engineering courses needed by transfer students to complete ME degree requirements. Most general education requirements will be met at the community college or other institutions the student previously attended. A copy of an existing articulation agreement between Montgomery College and UMBC is available. This will streamline the transition from MC to UMBC. UMBC offers pre-transfer advising at Montgomery College to ensure that MC students are taking the appropriate courses to fit into the 4-year program plan.

A full-time Program Director will be located at USG and will be responsible for the oversight of Mechanical Engineering at USG. The Program Director will report to the Department Chair of Mechanical Engineering and will work closely with the department's Undergraduate Program Director to ensure that the curriculum continues to meet ABET requirements. The next round of ABET accreditation is in Fall of 2023, and the program is expected to be reaccredited as of 2024. The assessment of student outcomes at the USG site will be a part of the reaccreditation self-study. The new accreditation will be retroactive for two years, so students graduating from the program at USG after October of 2022 will have an ABET-accredited degree. The students will be eligible to take the exams to become certified as Professional Engineers.

Additionally, Mechanical Engineering reviews its educational objectives using the following mechanisms:

- The Department of Mechanical Engineering has an active Industrial Advisory Board composed of representatives, including alumni, from local industry and government agencies. They are asked to review the educational objectives periodically.

- Selected courses in the Mechanical Engineering curriculum are reviewed to assess the degree to which the prescribed ABET student outcomes are being met. When needed, changes are made to the course pedagogy and/or content, and the course student outcomes are re-evaluated. This cycle occurs every three years, or twice during every six-year accreditation cycle.

- The Undergraduate Program Committee for Mechanical Engineering is focused on curriculum, assessment, and implementation of undergraduate curriculum including new/modified courses, new assessment plans to meet changing ABET requirements, course scheduling, and other relevant academic topics.

After each of these events, the department chair and ME's ABET/Assessment Committee convenes to determine if any changes are in order and, if so, to present them to the Mechanical Engineering faculty for discussion and a decision.

UMBC's Division of Professional Studies (DPS) has an existing infrastructure at USG that includes on-site staff who coordinate services to the academic programs. The UMBC staff at USG also provide an essential connecting role to offices and resources on the UMBC campus. The presence of five full-time

UMBC staff members at USG, along with the faculty members associated with the program, will ensure the continuous quality of the Program. The program will be subjected to the same standards that govern the main campus program. In partnership with the Office of Student and Academic Services at USG, UMBC will offer all the necessary services to ensure student success, and students will also have access to services on the main campus. Curricular oversight will be maintained at both campuses by the ME department. Faculty will be vetted by the Program Director and Department Chair. Instructors in the program will be eligible for the services provided by UMBC's Center for the Advancement of Teaching and Learning and will receive mentoring from the Program Director.

The outcomes below are the knowledge and skills students are expected to attain by the time of graduation:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In order to fulfill ABET accreditation requirements, the complete B.S. program requires 127 total credit hours. It will require 59 upper division credits taken at UMBC and 68 credits at a community college or other college or university. An associate's degree is not required for transfer admission into the Mechanical Engineering program, although some students may complete an associate's degree before transferring. The "Credit When It's Due" program allows students to earn an associate's degree after transferring to UMBC through reverse awarding of credit. Applicable coursework earned at UMBC is

transferred back to the community college and allows for the freedom of early transfer and the ability to earn an associate's degree and bachelor's degree in 127 credits. UMBC is committed to advising students about this program.

UMBC does require that all students complete a foreign language through the intermediate level or demonstrate proficiency at that level. The coursework for the language sequence typically requires three classes (for example SPAN 101, SPAN 102, and SPAN 201). UMBC students in a USG program can take these courses at a previous institution or be waived out the credits by demonstrating language proficiency.

Program requirements for the B.S. in Mechanical Engineering at USG are:

Lower-level credits transferred in from a community college or other college or university	68 credits
Required courses in Mechanical Engineering (as listed in Appendix A)	31 credits
Statistics course	4 credits
Technical electives in Mechanical Engineering (as listed in Appendix B)	9 credits
Social Science general education requirements*	9 credits
Arts and Humanities general education requirements**	6 credits
Total	**127 credits**

*UMBC departments already located at USG that offer courses fulfilling the social science general education requirement include: the Department of Sociology, Anthropology, and Public Health; the Department of Psychology; the Department of American Studies; the Department of History; the Department of Political Science; and the Social Work program.

**UMBC departments already located at USG that offer courses fulfilling the arts and humanities general education requirement include: the Department of Sociology, Anthropology, and Public Health; the Department of American Studies; the Department of History; and the Department of Political Science.

The website for UMBC's Department of Mechanical Engineering - https://me.umbc.edu/ - provides both current and prospective students information on curriculum, course descriptions, and degree requirements, as well as information about faculty, faculty research areas, technical requirements, scholarship opportunities, students groups, and academic policies. In addition, the Department regularly hosts open houses where prospective students can ask questions of department leadership. Once admitted, students will have access to academic advisors and faculty advisors to assist with scheduling and course selection. Information will be distributed between the Department and the students in several ways. Personal communications will be carried out by personal mail/email. General communications normally will be carried out by distributions of written messages and announcements in each Mechanical Engineering class and posted on doorways and bulletin boards as much as possible. All faculty members have an email address which is listed in the UMBC directory. All general messages from the department to students will be also be distributed to students via email.

At least once each semester the Mechanical Engineering Chair and the Undergraduate Coordinator will hold an open meeting to which all Mechanical Engineering Majors are invited. The purpose of this meeting is to discuss general departmental issues, problems, and new initiatives. The Mechanical Engineering Faculty are also invited to attend this meeting.

All students will be provided technical support for student accounts, such as their UMBC email address, and assistance with UMBC's Learning Management System, Blackboard, through UMBC's Division of Information Systems.

H. Adequacy of Articulation

An articulation agreement between Montgomery College and UMBC is available.

Most students are expected to take the majority of their General Education requirements at Montgomery College. UMBC will brief academic advisors at Montgomery College and the UMBC academic advisor at USG to ensure a smooth transition for students from Montgomery College to UMBC. No other articulation agreements are anticipated at this time.

I. Adequacy of Faculty Resources

Both current and newly- hired faculty will teach in the program at USG. A full-time Program Director will be located at USG and is responsible for the ME program at USG. The Chair of Mechanical Engineering, with concurrence of the Dean of COEIT, will appoint the Program Director. The Program Director shall have the qualifications (including a Ph.D.) to be appointed as a tenured faculty within the Department of Mechanical Engineering, and preference will be given to candidates with working knowledge of UMBC's academic policy, culture, and environment to ensure program success in its earliest stages. The Program Director will report to the Chair of Mechanical Engineering on all matters related to delivery of curriculum, personnel, and budget.

A table of faculty who will teach in the program, including their qualifications, areas of research, and proposed courses taught is in Appendix C.

In addition to the Program Director, the five-year hiring plan includes two Lecturers, and two Assistant Professors. These will be full-time positions and will teach more than 50% of the courses. The Professor of the Practice and Lecturer positions will require a minimum of a Master's degree in Mechanical Engineering or a related field. The Assistant Professor position will require a Ph.D. in Mechanical Engineering or a related field.

The chair of the Mechanical Engineering program will provide the program oversight. The current Chair, Dr. Ray Chen, is full professor with a Ph.D. in Aerospace Engineering from the University of Michigan.

As with the main campus, the faculty in the program will have access to UMBC's Center for the Advancement of Teaching and Learning, including all professional development training and workshops. Faculty will be eligible for annual conference travel funds.

Both tenure-track faculty and lecturers will be evaluated by the chair during the first year for contract renewal for the following two years, based on the initial student evaluation of teaching and the initial progress toward establishing of independent research and creative activities.

The Department Promotion and Tenure Committee (DP&TC) and the chair will conduct the mid-term, or the 3-year, review of the tenure-track faculty members for renewal up to and including the year for tenure and promotion review, usually conduct during the sixth year. The review, conducted during the third year, is based on the student teaching evaluations, service to the university community, promise of establishing independent research and creative activities and obtaining extramural research funding. The process is guided by Section 6.3 of the UMBC Faculty Handbook.

The tenure and promotion review follows the process described in Section 6.3 of the UMBC Faculty Handbook. Inputs from the Department Promotion and Tenure Committee (DP&TC), the chair, and authorities from outside UMBC comprise the data for evaluation.

J. Adequacy of Library Resources

Students in the program will have access to both the Albin O. Kuhn Library at UMBC and the Priddy Library at USG. Lynda Aldana, UMBC's Associate Director for Technical Services & Library IT Services, affirmed that the amount included in the attached budget for library resources is sufficient to cover any necessary additional materials. If needed, the projected increases for the library budget for this program will assist in covering cost increases or additional resources. All electronic resources at the Albin O. Kuhn library are available to UMBC students in programs at USG, including the online journal subscriptions and databases related to Mechanical Engineering. From the Priddy Library, UMBC students also have access to the full collection of research databases provided by the University of Maryland, College Park. The Priddy Library regularly acquires scholarly monographs on a variety of topics relevant to Mechanical Engineering. Monographs not already part of the collection can typically be added upon faculty request.

K. Adequacy of Physical Facilities, Infrastructure, and Instructional Equipment

UMBC has been offering programs at USG since 2001. The ME program will be located in the new Biomedical Sciences and Engineering Education Facility at USG. This building opened in November 2019. The laboratory space required by the Mechanical Engineering curriculum is available in the new building and USG will be furnishing the labs with the appropriate equipment. The start-up equipment will be owned by USG and funds used to purchase the equipment would be under the direction of USG. The approximate budget for this is $1,100,000.

UMBC at Shady Grove has administrative offices and access to classroom space, as well as an administrative staff of five. UMBC at Shady Grove has adequate facilities, infrastructure, and equipment to support the learning needs of the Mechanical Engineering students. Students will be provided with an email address and library account. UMBC uses Blackboard as the Learning Management System. Blackboard support is provided by UMBC's Division of Information Technology.

L. Adequacy of Financial Resources with Documentation

A projected 5-year budget is included in the proposal. Explanatory footnotes are included for line items in the budget. As shown in the budget table, revenue for the program will be a combination of tuition revenue and workforce development support from the University System of Maryland. Please note that

enrollment projections for the program are quite conservative, and actual tuition revenue may be more than projected.

M. Adequacy of Provisions for Evaluation of Program

The Mechanical Engineering program at USG will be subject to the same evaluation requirements as the main campus program. All students complete course evaluations at the end of each course. The results of these evaluations are provided to the department chair. The existing Mechanical Engineering program has educational objectives that are mapped to the courses within the program. As part of the ABET accreditation process, each of the courses has a set of student-learning outcomes (SLO) with specific assignments and associated rubrics to assess students' competency against the course SLOs.

N. Consistency with the State's Minority Student Achievement Goals

Inclusive excellence is a hallmark of UMBC. The University is one of the most diverse public research universities in the nation, with a minority enrollment of 49.8%. The Mechanical Engineering major is comprised of 18.1% underrepresented minorities. Additionally, according to the 2018 USG Fact Sheet, USG is a majority-minority campus with an ethnic diversity breakdown as follows:

33%	White
21%	African American
21%	Hispanic
14%	Asian
10%	Other
1%	Unknown

Offering the existing UMBC B.S. in Mechanical Engineering at USG allows the State of Maryland to provide a high-demand program from a diverse university to an even more diverse population of students.

O. Relationship to Low Productivity Programs Identified by the Commission

This is not applicable.

P. Adequacy of Distance Education Programs

This is not a distance education program.

Appendix A: Required Courses for all ME majors (31 Mechanical Engineering credits and 4 Statistics credits)

ENME 301 - The Structure and Properties of Engineering Materials (3 credits) The nature and properties of engineering materials as related to their use in all phases of mechanical engineering will be studied. Materials covered include metals, ceramics and glasses, polymer and composites**.**
ENME 303 - Computational Methods for Engineers (3 credits) This course is intended as an introduction to programming using MATHLAB, elements of linear algebra, computational methods, and their application to solving engineering and specific problems through computational programming. Solution of ordinary differential equations with application in engineering**.**
ENME 304 - Machine Design (3 credits) In-depth design course that is a follow-up to ENME 204. The focus here is on designing machine components. Emphasis is on kinematics, working stresses, repeated loadings, fatigue and heating effects. The course requires completion of a design project and the use of such computational tools as CAD and engineering codes. Note This course may be subject to a Course Materials Charge. The charge may vary by semester, depending on the course materials required. The Course Materials Initiative (CMI) was established to provide students with more affordable course materials, enhance the students' experience on a common digital platform via Blackboard, and position UMBC to be ahead of the curve with digital content.
ENME 320 - Fluid Mechanics (**3 credits**) Fluid flow concepts and basic equations, effects of viscosity and compressibility, dimensional analysis and laws of similarity, flow through pipes and over-immersed bodies, and principles of flow measurement.
ENME 321 - Transfer Processes (3 credits) Conduction by steady state and transient heat flow; laminar and turbulent flow; free and forced convection; radiation, evaporation and condensation of vapors; and transfer of mass, heat and momentum.
ENME 332L - Solid Mechanics and Materials Laboratory (3 credits)

A laboratory course in testing mechanical properties of materials. Emphasis will be on experimental techniques in solid mechanics, strain gages, strain gage rosettes, photoelasticity, acoustic emissions, metallurgical and electron microscopy.
ENME 360 – Vibrations (3 credits) Dynamic characteristics of machinery with emphasis on systems with single and multiple degrees of freedom.
ENME 403 - Automatic Controls (3 credits) Hydraulic, electrical, mechanical and pneumatic automatic control systems; open and closed loops; steady-state and transient operations; stability criteria; linear and non-linear systems; and Laplace transforms.
ENME 432L - Fluids/Energy Laboratory (2 credits) Measurement of fluid properties, fluid forces and observation of flow phenomenon; demonstration of flow measurement techniques; and measurement of heat-transfer properties: conduction, convection and radiation; and condensation and evaporation measurements.
ENME 444 - Mechanical Engineering Systems Design (3 credits) This course allows students completing the Mechanical Engineering curriculum to engage in a complete system design experience, integrating the various technical concepts they have learned in prior courses and is the last in a sequence of design courses that are an integral component of the undergraduate program. The course imparts a foundation in team leadership and project management and emphasizes entrepreneurial skills necessary to function in any organization, regardless of size. Engineers in industry solve problems that simultaneously resolve budgetary, time, technical and sometimes social, ethical and environmental constraints. Students will enjoy an experience that closely matches this environment**.**
ENME 482L - Vibrations/Controls Laboratory (2 credits) Various methods of spectral and modal analysis. Open-and closed-loop control experiments Methods and instrumentation for determining the vibration properties of mechanical systems.
STAT 355 Probability and Statistics (4 credits) An introduction to applied statistics designed for science majors and others with demonstrated quantitative ability. Topics include nature of statistical methods, random variables and their distribution functions, general principles of estimation and hypothesis testing. A laboratory introduces students to computer techniques in statistical analysis

Appendix B: Mechanical Engineering electives expected to be offered at USG (Nine credits required.)

ENME 408 - Selected Topics in Engineering Design (3 credits)

Three lecture periods per week. Creativity and innovation in design, generalized performance analysis, reliability and optimization as applied to the design of components and engineering systems, use of computers in design, and design of multivariable systems. Note May be repeated for a maximum of nine credits with permission of advisor and allowed multiple enrollment in term.

ENME 409 - Mechanics of Deformable Solids (3 credits)

Introduction to the mechanics of engineering materials in three dimensions, concepts of stress and strain, generalized Hooke's law and equilibrium of solids. Modes of failure, including plasticity, stability, fatigue and fracture, will be treated. This course is repeatable for credit.

ENME 410 - Operations Research I (3 credits)

Applications of linear programming queuing model, theory of games and competitive models to engineering problems.

ENME 412 - Mechanical Design for Manufacturing and Production (3 credits)

Physical properties of materials and review of fundamental principles of product design. Various classes of engineering materials are characterized. Types of manufacturing processes that can be applied to the production of the design are discussed.

ENME 416 - Intermediate Thermodynamics (3 credits)

Application of the first and second laws of thermo-dynamics in the analysis of basic heat engines, air compression and vapor cycles, and heat sources in fossil fuels and nuclear fuels.

ENME 422 - Heat Transfer in Biological Systems (3 credits)

This is a cross-listed course offered to upper level undergraduate students as a science elective, and regular graduate students. The course focuses on how heat transfer mechanisms and principles are applied to biological systems. It includes how to model heat transfer in tissue with blood perfusion, major experimental approaches for measuring thermal and physiological properties of tissue, as well as detailed description of various aspects of bioheat transfer analyses in hyperthermia treatment to kill tumor.

ENME 423 - Heating, Ventilation and Air Conditioning Design (3 credits)

Topics will include heating and cooling load calculations; psychrometrics applied to HVAC design, thermodynamics of refrigeration, space air diffusion, piping and duct flow analysis, introduction to solar energy and indoor air quality
ENME 471 - Computer Aided Finite Element Based Design (3 credits) This course introduces the method of finite elements as a tool for mechanical design. The concepts of geometry descritization and function interpolation are used in formulating the linear finite element equations. Various types of elements and general guidelines of finite element modeling are presented. The one-dimensional model is fully formulated, and aspects of nondimensional finite element modeling are presented. During the two-hour weekly labs, students are introduced to several finite element packages, such as the I-DEAS, ABAQUS and in-house DENDRO softwares. Emphasis is placed on the use of Integrated Design and Analysis Software (IDEAS), which is required for the completion of term design projects.
ENME 472 - Materials and Processes for Micro/Nanoscale Systems (MEMS) (3 credits) A fundamental course presenting key topics in materials and processing for the design and manufacture of micro and nano scale systems often called microelectromechanical systems (MEMS). Students will focus on understanding materials and microfabrication technologies commonly employed in these smallscale systems. Material properties, parameters and their relationship with microfabrication processes, length scale and applications are discussed with regards to elastic and inelastic deformation, fracture, residual stress, fatigue, creep, adhesion, and stiction. Case studies on devices for sensing and actuation applications will be addressed to connect the course topics. Recommended Preparation ENME 301, ENME 220
ENME 488 - Special Problems (3 credits) Advanced problems in mechanical engineering, with special emphasis on mathematical and experimental methods. This course is repeatable for credit. Recommended Preparation Permission of department chairman and senior standing in mechanical engineering.
ENME 489 - Special Topics in Mechanical Engineering (3 credits) Selected topics of current importance in mechanical engineering. This course is repeatable for a maximum of 9 credits or 3 attempts. Recommended Preparation Senior standing and permission of department. Note May be repeated for a maximum of nine credits with permission of student's advisor.

Appendix C: ME faculty, specializations, and courses taught

Faculty	Specialization	Course(s) taught
Dr. Charles Eggleton, Ph.D., Professor	Thermofluids	ENME 320, ENME 432L
Dr. LDT Topoleski, Ph.D., Professor	Solid Mechanics-Material Science	ENME 301
Dr. Weidong Zhu, Ph.D., Professor	Design System Dynamics	ENME 360
Dr. Marc Zupan, Ph.D., Associate Professor	Solid Mechanics-Material Science	ENME 332L
Dr. Anthony Farquhar, Ph.D., Associate Professor	Design System Dynamics	ENME 304
Dr. Roy Wu, Ph.D., POP	Design System Dynamics	ENME 303, ENME 403, ENME 482L

Projected Budget for UMBC's proposed B.S. in Mechanical Engineering at USG

TABLE 1: RESOURCES					
Resources Categories	FY23	FY24	FY25	FY26	FY27
1.Reallocated Funds	0	0	0	0	0
2. Tuition Revenue[6,7] (c+g below)	138,322	393,408	599,060	755,230	908,396
a. #F.T Students[8]	13	36	53	65	76
b. Annual Tuition Rate	9,226	9,487	9,748	10,010	10,271
c. Annual Full Time Tuition Revenue (a x b)	119,938	341,532	516,644	650,650	780,596
d. # Part Time Students[9]	4	11	17	21	25
e. Credit Hour Rate	383	393	404	415	426
f. Annual Credit Hours	48	132	204	252	300
g. Total Part Time Tuition Revenue (e x f)	18,384	51,876	82,416	104,580	127,800
3. Grants, Contracts, & Other External Sources[10]	900,000	900,000	900,000	900,000	900,000

[1] This assumes a 3% tuition increase annually.
[2] This includes only tuition revenue as fees are treated as a pass through to USG.
[3] This includes both new and continuing students.
[4] This includes both new and continuing students.
[5] The University System of Maryland is providing workforce development funds for this initiative.

4. Other Sources	0	0	0	0	0
TOTAL (Add 1 - 4)	1,038,322	1,293,408	1,499,060	1,655,230	1,808,396

TABLE 2: EXPENDITURES					
Expenditure Categories	FY23	FY24	FY25	FY26	FY27
1. Total Faculty Expenses (b + c below)	455,948[11]	496,692[12]	661,853[13]	802,861[14]	838,830[15]
a. # FTE	3	3	5	6	6
b. Total Salary	340,260	377,729	493,920	599,150	629,849
c. Total Benefits	115,688	118,963	167,933	203,711	208,981
2. Total Administrative Staff Expenses (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0

[6] Faculty lines for Year 1 include a Program Director, a Lecturer and an Assistant Professor.
[7] In Year 2, adjunct faculty will be added.
[8] In Year 3, another Assistant Professor position will be added.
[9] In Year 4, an additional full-time Lecturer will be added.
[10] In Year 5, additional adjunct faculty will be used.

3. Total Support Staff[16] Expenses (b + c below)	19,281	40,821	51,531	63,986	73,231
a. # FTE	0	0	0	0	0
b. Total Salary	12,725	26,941	34,010	42,230	48,332
c. Total Benefits	6,556	13,880	17,521	21,756	24,889
4. Equipment[17]	28,800	29,520	30,229	30,927	31,613
5. Library	3,000	3,180	3,371	3,573	3,787
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses[18]	372,568	545,795	737,272	607,084	743,912

[11] Support staff for UMBC at USG is shared by all UMBC USG programs. These expenses are an estimate of Mechanical Engineering's share of the support staff's time.
[12] This includes computing needs for faculty and staff.
[13] Other expenses includes start-up costs, indirect costs, funding for honorariums, travel, supplies, fixed charges such as association dues, graduate assistants, subscriptions, and rental of classrooms and staff offices at USG.

TOTAL (Add 1 - 7)	879,597	1,106,008	1,484,261	1,508,431	1,691,373

Office of the Provost
University of Maryland, Baltimore County
1000 Hilltop Circle
Baltimore, MD 21250

PHONE: 410.455.2333
FAX: 410-455-1107
www.umbc.edu

June 07, 2021

James D. Fielder, Jr. Ph.D.

Maryland Higher Education Commission

6 North Liberty Street

Baltimore, MD 21201

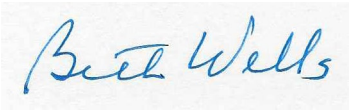
Dear Secretary Fielder:

This is with reference to UMBC's proposal to offer the upper division of its outstanding Bachelor of Science in Mechanical Engineering at the Universities at Shady Grove.

The articulation agreement and the draft MOU that describes the operating arrangements among UMBC, Montgomery College, and USM for offering ME at USG are submitted here to MHEC with the proposal. We request that the MOU not be circulated publicly when MHEC sends the proposal for the 30-day review.

Thank you very much.

Sincerely,



Beth Wells
Director of Academic Administration

DRAFT

Memorandum of Understanding between
University System of Maryland (USM) and
University of Maryland, Baltimore County (UMBC) and
The Universities at Shady Grove (USG)
_____ 2021

1. Purpose

This Memorandum of Understanding ("MOU") constitutes an agreement between the University System of Maryland ("USM"), University of Maryland, Baltimore County ("UMBC") and the Universities at Shady Grove ("USG") to support offering the upper division of a Bachelor of Science (BS) degree in Mechanical Engineering ("BSME") at USG. This MOU was jointly developed and includes the duties and obligations of each party and relevant resource requirements to launch and operate this program ("the Program") at USG.

2. Rationale for Proposed Program

UMBC is proposing to bring the upper division of an undergraduate program to USG funded through the FY19 Governor's Workforce Development Initiative (WDI) funding. This MOU between UMBC, USG and USM outlines the arrangements to support the upper division of:

- UMBC's B.S. in Mechanical Engineering provides students with the knowledge, skills, and awareness of the theory, design, development, and application of mechanical engineering.

    - Currently, there are no universities who offer a B.S. in Mechanical Engineering at USG, presenting an opportunity for UMBC to offer this high demand program. Expanding this program to the Montgomery County campus will provide affordable educational opportunities to the residents of Montgomery County and support the state economy by generating qualified engineering professionals. According to O*NET, an occupational information database sponsored by the U.S. Department of Labor, the number of job openings for Mechanical Engineering in Maryland is expected to increase by 4% during the period 2016 - 2026. Additionally, in Fall 2018, 20% of the incoming Freshman and 19% of the transfer students were residents of Montgomery County. There is a significant pipeline of students from Montgomery County interested in UMBC's B.S. in Mechanical Engineering. The program at USG gives additional options to students who are residents of Montgomery County and the surrounding areas and want to take classes at USG.

3. USM's General Funding Principles for Support of New or Expanded High-Cost Programs at USG

The USM, in concert with USG and its institutional partners, has developed a set of guiding principles to help establish a general framework, by which new, high-cost programs, or expansion of current programs being proposed for USG can be successfully mounted, and sustained to the mutual benefit of the participating institutions and USG (and the citizens and businesses in Montgomery County served by them). This framework is used when the financial and operational model(s), by which USM institutions have traditionally developed and implemented programs at USG, cannot adequately support the development or expansion of key programs, such as high-cost, resource-intensive programs in engineering, technology, and the life/health care sciences.

These principles include:

- The cost of establishing and operating programs will be shared between USG and the institutions.

- Costs will be apportioned according to the details of MOUs, to be negotiated between USG and the individual institutions.

- Each MOU will include (or authorize the development of) appropriate performance metrics, negotiated and agreed upon by both the participating institutions and USG, which will be used to help assess the program's progress, effectiveness, and viability.

- To provide the financial and operational stability that institutions need to plan and build successful programs—and allow USG to maximize the resources available to it, in support of its mission—the MOUs should specify a guaranteed period of funding for each program that will continue on a rolling basis, so long as each program meets the terms and conditions agreed upon by the institutions and USG. In the event that any program funded through the MOU process is required to cease operations at USG, both the institution and USG will work together to plan and implement an orderly and effective phase out of the program, including completion of all teach-out requirements, and the transition of faculty as needed and appropriate, per the requirements of state, Regent, and accreditor policies.

- Faculty staffing and workload decisions/requirements related to programs operating within the Biomedical Sciences and Engineering Education building (BSE) will remain the sole responsibility of the home institution. Both the USG and the USM recognize that campuses require flexibility in how they holistically structure, administer, and support their programs both on campus and at the regional centers, if they are to be successful long term. However, an underlying principle of the MOUs is that funding supplied by USG or USM to the institutions to cover "gap costs" -- those ongoing structural deficits associated with operating high cost programs that cannot be recouped through the revenue models traditionally employed by campuses in support of their operations at USM's regional centers -- should go primarily to build and support the educational quality of the programs, and instruction being offered.

- Institutions and USG are expected to work together to identify and achieve efficiencies in academic programs, support services as appropriate, and practice these general principles.

It is the determination of the USM and USG that, based on the information provided, the Programs meet the definition of high-cost programs, envisioned under this framework. Therefore, the principles outlined above have been used to develop this MOU, which outlines the financial and operational expectations/requirements for the deployment and operation of the Programs at USG.

4. Financial and Operational Expectations/Requirements for the Programs at USG

4.1 Funding

Funding for the Program under the five years of operations and two investment years, covered by this MOU will come from a variety of sources, including: tuition and fee revenue generated by students enrolled in the program at USG, internal resource reallocations made at the discretion of UMBC, and FY 2019 Workforce Development Initiative funding provided by the USM and USG to UMBC for the support of the Program. A detailed portrayal of the revenue and expenses (including those tied to instruction, support, supplies and equipment, marketing, and space) is provided in the attached schedule, developed by UMBC. The enrollment

projections from which these revenue/expense estimates are derived are included as well. These enrollments and revenue/expenses may change, and will be reviewed as part of the yearly review by UMBC and USG.

The revenue/expense data provided by UMBC for FY 22 (year zero) through FY 27 (year five) can be broken down into three parts:

1) Projected tuition and fee revenue that will be generated by enrollment within the Program at USG;
2) Program expenses that will be funded by using tuition and fee revenue. These expenses are split between both instructional personnel costs (adjuncts) and operating expenses, and will be funded by UMBC using tuition revenue (this category includes the administrative indirect charge applied by UMBC);
3) Program expenses that USM and USG will fund through use of Workforce Development Initiative funds. These expenses include designated faculty and administrative personnel costs, as detailed in the UMBC schedule, and include their estimated fringe benefit costs and, for the research faculty, a portion of their start up package as we wish to ensure that the USG undergraduates have the same opportunities to be engaged with and benefit from participation in faculty-led research projects as the undergraduates at the UMBC home campus do.

Under the terms of this MOU, UMBC, using the tuition revenue projected in the attached schedule, will cover all Program expenses noted in the schedule (*"Expenses to be supported by tuition revenue"*). Tuition revenue generated by the Program is projected to range from $132,393 in FY 23 to $869,404 in FY 27. Expenses that UMBC commits to funding using tuition are projected to range from $81,351 in FY 22 to $748,693 in FY 27. Importantly, it is the expectation of USM and USG—based on agreements made with the UMBC leadership—that any tuition revenue generated from the Program at USG that exceeds the expenses identified in the schedule, shall be used by UMBC to reinvest in programming at USG, either through new programs, enhanced capacity of existing programs, or other improvements.

In turn, under the terms of this MOU, the USM and USG commit to fully funding all personnel costs identified in the schedule ("*Expenses to be supported by USM"*), including the expenses identified as Undergraduate Instruction Focused Research Support and classroom start up expenses. Teaching labs have already been equipped as part of the outfitting of the BSE. Funds used to purchase lab-start-up equipment in the BSE would be under the direction of USG in order to understand their impact on classrooms, facilities and IT support at USG. The start-up equipment would be USG-owned. USM and USG would provide Workforce Development Initiative funding sufficient to cover non-tuition supported expenses (including funding up to 25% of under attainment of tuition) at a set amount each year of $900,000.

A portion of the annual funding will be used on the UMBC Catonsville campus for undergraduate research activities engaging the USG undergraduates. UMBC has built a reputation for involving undergraduates in cutting edge research. Students can apply for scholarships that can be used to provide a modest stipend, purchase research materials, and fund conference registration and travel, or any combination of these. Students who participate will present their work at the end of each spring semester to the campus community. The research activity funds will be used to provide the same opportunity for students located at the Shady Grove campus as currently available for students at the Catonsville campus. Funds will be used to

(1) purchase state of the art equipment for undergraduate students to conduct research projects under the supervision of faculty, with or without the collaboration of graduate students;

(2) provide stipends to undergraduate students and graduate students. The latter will manage the lab by making the lab available on a regular basis and providing supervision when undergraduate students are working on projects;

(3) pay for tools, materials/consumables, fabrication tools and costs, and costs and expenses related to conference attendance.

For a detail by year of the amount of funding committed by USM/USG to the Program, see the attached schedule.

4.2 Enrollment and Graduate Production

In return for the funding support outlined above, UMBC estimates headcount enrollment as follows:

1) By FY 23, enroll at least 17 (headcount) students in the Program.
2) By FY 24, enroll at least 48 (headcount) students in the Program.
3) By FY 25, enroll at least 70 (headcount) students in the Program.
4) By FY 26, enroll at least 86 (headcount) students in the Program.
5) By FY 27, enroll at least 101 (headcount) students in the Program.

The following are the estimates of the number of degrees awarded during this time period:

1) FY 25, 6 degrees awarded
2) FY 26, 16 degrees awarded
3) FY 27, 26 degrees awarded

4.3. Funding Start Date, Transfer to USG, and Program Review and Evaluation Requirements

Initial transfer of funds from USM/USG to UMBC, per the terms of this MOU and the schedule provided, is expected to occur in FY 21. This will allow UMBC to begin hiring program faculty/staff under the Program prior to accepting enrollment.

At the beginning of FY 25, UMBC, USG, and USM will undertake a review of the status of the program, including such factors as enrollment in the program (both historical and projected), the annual cost of operating the program against the revenue generated (both historical and projected), the total number of graduates produced (historical and projected), other agreed upon program outcomes, and the need for continued additional operational subsidies (i.e., any "gap" between tuition revenues and identified program costs) going forward. UMBC, USM, and USG will then have the option of negotiating a new MOU or, if deemed appropriate and agreed to by the chancellor, beginning the process for reducing and/or phasing out of the program.

This agreement becomes effective upon signature by authorized representatives of UMBC, USG and USM. It remains in effect unless modified or terminated in writing by executives from all three parties. This MOU may be modified only by mutual written agreement of all parties, subject to final approval by the USM Chancellor.

5. Other Key Duties and Obligations Under the MOU

UMBC will:

- Share data and information necessary to establish and operate the Program and ensure their success. This includes data and information related to the development of the pathways (e.g., articulation agreements and curriculum changes), recruitment/acceptance of students (e.g., number of qualified applications, waitlist, acceptance rates), and program enrollments and projections, retention and graduation rates and other metrics as deemed appropriate.
- Share data and information required by USG to maintain campus-wide safety and security as well as the provision of student and academic services, as identified in the current slate of student services provided

by USG. In addition, will submit status reports to USG and USM each semester that outline the progress of the Program, and any additional challenges/opportunities that the Program has encountered.

- Meet with USG annually to review and discuss progress under the Program, and any additional challenges/opportunities that the Program has encountered. This will include reviewing progress toward enrollment projections and other agreed upon performance metrics (e.g., demand for the program, degree outputs). This annual review is separate from the more comprehensive 3-year review set forth in section 4.3 above.
- Set as enrollment targets the minimum level of enrollment outlined in the schedule provided by UMBC. Differences between estimated and actual FTE projections will be part of the ongoing status reports.
- Partner with USG on mutually beneficial development efforts to support the Program, including grant funding opportunities as they may arise to enhance the Program.
- Actively encourage faculty, students, and staff to participate in inter-professional events, curriculum, and experiential opportunities with other programs at USG.
- Recruit, hire, and manage faculty and staff for the Program at USG.
- Honor all previously executed or subsequently executed agreements with USG, including agreements on: counseling services, the delivery of student and academic services, support for students with disabilities, student information, and data sharing.
- Partner with USG to identify and achieve efficiencies in academic programs, support services as appropriate, and practice these general principles.
- Continue to adhere to the current funding policy and fee schedule for all programs at USG, including auxiliary student fees, technology fees, room charges and parking fees for students, faculty and staff, and continue to pay USG for student services provided for UMBC students, per the existing student services agreement. Under these arrangements, USG will continue to serve all UMBC students enrolled in the classes for these programs.
- Continue to follow existing policy and procedures for establishing a new academic program at USG including timely MHEC filings as well as the required submittals to USG with regard to the academic program proposal. The program proposal must be approved by USG's Shady Grove Governing Council (the "SGGC"). The UMBC program proposals submitted to USG are attached.

USG will:

- Provide funding for the Program in FY 21-FY 27, per the requirements and expectations identified in Section 4 of this MOU.
- Provide suitable office, classroom, and computer lab space for the Program, including equipment.
- For the period that begins in FY 28, work with USM and UMBC to ensure the continued adequacy of funds to cover the identified costs of the Program, as identified and agreed upon by the three parties.
- Meet with UMBC annually to review and discuss progress under the Program, and any additional challenges/opportunities that the Program have encountered. This will include reviewing progress toward enrollment projections and other agreed upon performance metrics (e.g., demand for the program, degree outputs). This annual review is separate from the more comprehensive 3-year review set forth in section 4.3 above.
- Partner with UMBC on mutually beneficial development efforts to support the Program, including grant funding opportunities, as they may arise, to enhance the Program.
- Partner with UMBC to actively encourage faculty, students and staff to participate in inter-professional events, curriculum, and experiential opportunities with other programs at USG.
- Honor all previously executed or subsequently executed agreements with UMBC, including agreements on: counseling services, the delivery of student and academic services, support for students with disabilities, student information, and data sharing.
- Partner with UMBC to identify and achieve efficiencies in academic programs, support services as appropriate, and practice these general principles.

- Continue to provide current funding policy, fee schedules, and invoices to UMBC that include auxiliary student fees, technology fees, room charges, and parking fees for students, faculty and staff, in accordance with standard existing procedures at USG for all home institutions.
- Continue to follow existing policy and procedures for establishing a new academic program at USG, including the required submittals with regard to the academic program proposal. The program proposal must be approved by the SGGC.

USM will:

- Provide the Workforce Development Initiative funds requested by USG for the Program beginning in FY 21 and continuing through FY 27, as identified in Section 4 above.
- Work with USG and UMBC to solve any funding needs that may require modification in the FY21-FY27 period.
- For the period that begins in FY 28, work with USG and UMBC to ensure the continued adequacy of funds to cover the costs of the Program, as identified and agreed upon by the three parties.

6. Program Contacts

UMBC and USG designate the following individuals as those with the responsibility of coordinating the MOU implementation in general terms:

- UMBC: Dr. Phillip Rous, Provost and Senior Vice President for Academic Affairs and Dr. Christopher Steele, Vice Provost, Division of Professional Studies.
- USG: Dr. Anne Khademian, Executive Director and Associate Vice Chancellor for Academic Affairs, USM, Ms. Mary Lang, Chief Strategy Officer, Ms. Nico Washington, Chief Operating and Financial Officer
- USM: Ms. Ellen Herbst, Chief Operating Officer/Vice Chancellor for Administration and Finance, Dr. Joann Boughman, Senior Vice Chancellor for Academic and Student Affairs

7. Date and Signatures of MOU and Authority to Execute

This MOU shall be effective upon the date of the final signature by the authorized representatives of the parties. The undersigned individuals represent and warrant that they are expressly and duly authorized by their respective institutions to execute the MOU.

8. Required Signatures

The parties identified below agree to the provisions and terms of this MOU.

APPROVED:

_____

Philip Rous, Ph.D. Date
Provost and Senior Vice President for Academic Affairs
UMBC

_____
Anne Khademian, Ph.D Date
Executive Director
The Universities at Shady Grove
Associate Vice Chancellor for Academic Affairs
University System of Maryland

_____
Ellen Herbst Date
Chief Operating Officer
Vice Chancellor for Administration & Finance
University System of Maryland

_____
Dr. Joann Boughman Date
Senior Vice Chancellor for Academic & Student Affairs
University System of Maryland

Three attachments:

A. Spreadsheet of UMBC Costs submitted by UMBC
B. Program Proposal submitted to APAC
C. UMBC Template for Annual Information Report

Articulation Agreement Amendment

Montgomery College
9221 Corporate Blvd
Rockville, Maryland, 20850

University of Maryland, Baltimore County (UMBC)
1000 Hilltop Circle
Baltimore, Maryland 21250

This Amendment is executed this 19th day of February, 2018, between Montgomery College, 9221 Corporate Blvd, Rockville, Maryland, 20850, and the University of Maryland, Baltimore County, a constituent institution of the University System of Maryland, and agency of the State of Maryland.

The parties agree to the following:

Effective Spring 2018, UMBC will cease the practice of considering waivers to the physical education graduation requirement on the basis of age, with the exception of cases involving:

- *Students who matriculated to UMBC prior to Spring 2018 and have been continuously enrolled (no break in enrollment), who were 30 years of age or older before their first enrolled semester at UMBC;*

- *Students who matriculate to UMBC prior to Spring 2020 having previously attended a Maryland Community College or another institution prior to Spring 2018 under an established articulation agreement and who were 30 years of age or older before their first enrolled semester at UMBC.*

As of the Execution Date of this Amendment, all the provisions of this Amendment shall be deemed to be incorporated in, and made a part of, the Articulation Agreement with Montgomery College, and shall be read, taken and construed as one and the same instrument. Except as otherwise expressly modified herein, the Articulation Agreement shall remain in full force and effect, in accordance with its terms.

Philip Rous

Philip Rous, Ph.D.
Provost and Senior Vice President for Academic Affairs
University of Maryland, Baltimore County

Sanjay Rai, Ph.D.
Senior Vice President for Academic Affairs
Montgomery College

Read and Understood

Katharine Cole

Katharine H. Cole, Ph.D.
Vice Provost and Dean of Undergraduate Academic Affairs
University of Maryland, Baltimore County

DocuSigned by:
Christopher Tkacik

Approved for Legal Sufficiency
Office of the General Counsel
University of Maryland, Baltimore County

Articulation Agreement

Montgomery College
Associate of Science in General Engineering
900 Hungerford Drive
Rockville, MD 20850

University of Maryland, Baltimore County
Bachelor of Science in Mechanical Engineering
1000 Hilltop Circle
Baltimore, Maryland 21250

Entered into this 15th day of August, 2013.

Philip Rous, Ph.D.
Provost and President for Academic Affairs
University of Maryland, Baltimore County

Donald M. Pearl, Ph.D.
Senior Vice President for Academic Affairs
Montgomery College

Read and Understood

Warren DeVries, Ph.D.
Dean, College of Engineering and Information Technology
University of Maryland, Baltimore County

Eun-Woo Chang, Ph.D.
Instructional Dean, Science, Engineering and Math
Montgomery College

Charles Eggleton, Ph.D.
Chair, Mechanical Engineering Department
University of Maryland, Baltimore County

Muhammad Kehnemouyi, Ph.D.
Chair, Science Engineering and Math
Montgomery College

APPROVED
UMBC
Office of General Counsel

This agreement is applicable for students enrolled at Montgomery College (MC) upon the execution date of this agreement. This agreement may be modified by the mutual written consent of both parties. This agreement may be terminated by either party by giving notice six months in advance to the other party. Such termination will not affect the participation in the articulated programs of those MC students who have been fully or conditionally admitted to UMBC.

Any notice to be given hereunder shall be given in writing by U.S. mail or via reputable overnight courier (e.g., Federal Express, DHL, etc.). Notice shall be deemed received upon delivery to the party to whom the notice is directed or to its agent, in the case of UMBC to: UMBC, 1000 Hilltop Circle, Baltimore, Maryland 21250, Attn: Dr. Philip Rous, Provost, with copies to Dr. Diane Lee, Vice Provost and Dean, Undergraduate Education, Dr. Yvette Mozie-Ross, Associate Provost, Enrollment Management, and Steven Smith, University Registrar, UMBC ; and, in the case of MC to: 900 Hungerford Drive, Rockville Maryland 20850, Attn: Andrea Milo, Acting Director of Articulation, Transfer and Academic Services. Notwithstanding the foregoing, in the event that this Agreement provides that any notice must be directed to a person other than the person designated for the receipt of notice in the preceding sentence, then notice must be directed to such other person in order to be effective hereunder.

This Agreement embodies the entire agreement and understanding among the parties hereto relating to the subject matter hereof and may not be changed orally, but only by an instrument in writing signed by all parties hereto. No representation, warranty, undertaking or covenant is made by any party hereto except as contained herein and any others are specifically disclaimed. This Agreement shall be governed by and construed in accordance with the internal laws of the State of Maryland (i.e., without regard to its conflicts of law rules). This Agreement shall be binding upon the parties hereto and their respective successors, but shall not inure to the benefit of any third party beneficiary. This Agreement and any rights hereunder may not be assigned by either party without the prior written consent of the other, and any purported assignment without consent shall be null and void and of no effect whatsoever. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same Agreement.

This Articulation Agreement continues on the next page.

Articulation Agreement

Montgomery College

Associate of Science in General Engineering

University of Maryland, Baltimore County (UMBC)

Bachelor of Science in Mechanical Engineering

This agreement is initiated this day, August 15, 2013 between Montgomery College, 900 Hungerford Drive, Rockville, MD 20850, hereafter "MC," and the University of Maryland Baltimore County, a constituent institution of the University System of Maryland, and agency of the State of Maryland, hereafter "UMBC," to facilitate the transfer of students earning the Associate of Science degree in General Engineering at MC to UMBC in pursuit of the Bachelor of Science degree in Mechanical Engineering.

I. PURPOSE

The purpose of this Articulation Agreement (the "Agreement") is to establish a collaboration between UMBC and MC in an effort to facilitate the transfer and degree completion of students earning the Associate of Science in General Engineering at MC to the Bachelor of Science in Mechanical Engineering at UMBC.

This Agreement also serves as a Memorandum of Understanding between both institutions for the purpose of clarifying roles and responsibilities in this partnership.

II. GUIDING PRINCIPLES

In consideration of the mutual covenants and conditions expressed herein, the parties agree to the following:

General Requirements

1. All courses meeting general education requirements at MC will transfer and be applied towards the general education requirements at UMBC.
2. A completed general education program shall transfer without further review or approval by UMBC and without the need for a course-by-course match.
3. A maximum of 65 credits will transfer from MC, a 2-year degree-granting institution.
4. Upon matriculation to UMBC, MC students must satisfy all general education, graduation and major requirements as outlined in the UMBC Undergraduate Catalog.
5. MC students must take a minimum of 30 credit hours at UMBC to earn a bachelor's degree. The final 30 credits must be earned at UMBC.
6. UMBC requires a minimum of 120 credit hours to attain a bachelor's degree.

Advising/Academic Planning

1. Students should work closely with their academic advisor at MC to develop an academic plan to ensure a seamless transition.

2 Students and advisors are encouraged to utilize a variety of advising resources including the UMBC Undergraduate Catalog, Suggested Transfer Pathways, departmental websites, as well as ARTSYS (the USM online articulation database), to ascertain transferability of coursework.

3 Following admission to UMBC, students will receive an evaluation of prior college coursework via myUMBC. The evaluation will include a Transfer Credit Report and a Degree Audit detailing prior coursework, transferability and applicability to UMBC general and university requirements.

4 Prior to matriculation to UMBC, all new students are required to attend the mandatory new student orientation program. During orientation, students will meet with an academic advisor to review prior coursework, discuss academic interests and goals, and develop an academic plan.

5 Upon matriculation, students will be assigned an advisor in their area of study. Students are strongly encouraged to meet with their advisor periodically. Students are required to meet with their advisor prior to registering for subsequent semesters.

Admissions

1 The UMBC Admissions Committee evaluates transfer applicants on the basis of their academic record at previous institutions. Cumulative grade point average, performance trends, strength of curriculum and performance in courses related to the intended area of study are considered.

2 Applicants successfully completing the articulated program with a 2.0 or better grade point average who have not subsequently matriculated at any other institution of higher education will be guaranteed transfer admission to UMBC. Additional requirements may apply on selective admissions programs (e.g. Engineering, Visual Arts, Performing Arts). A history of acts identified in the Federal Campus Security Act may disqualify a candidate for guaranteed admission.

Scholarships and Financial Aid

Students transferring from MC to UMBC who meet application deadlines, academic and financial qualification that apply to all students, may be eligible for consideration for the following scholarships offered by UMBC:

a) The Academic Achievement Award for Transfers (AAAT) – awarded to community college transfers on the basis of academic accomplishment. Awards of up to $2,500 for each of two academic years of study. May be used for full- or part-time study. Students must have completed 35 or more college level credits at the time of application to be eligible for consideration.

b) Phi Theta Kappa (PTK) Scholarship – awarded to community college transfers on the basis of academic accomplishment. Awards range from $2,000 to $2,500 per year for each of two academic years of study. May be used for full- or part-time study. Students must submit proof of PTK membership to be eligible for consideration.

c) Honors College Scholarship – Transfer students admitted to the Honors College may be eligible for a $1,000 award per year for each of two years of academic study.

d) Transfer Student Alliance (TSA) - awarded Montgomery College transfers who complete the associate's degree and meet all other program requirements. Awards of $1,500 dollars for each of two years of full-time study.

1 To maximize consideration for need-based aid, students are encouraged to complete the free Application for Federal Student Aid (FAFSA) as soon as possible after January 1 but prior to February 14 for fall admission.

Ongoing Collaboration

1. In the spirit of articulation, faculty representatives from both institutions will meet annually to engage in ongoing discussion to enhance and strengthen this collaboration.
2. UMBC Engineering faculty may serve as a resource as available to MC students and faculty by serving as guest lecturers, workshop/seminar facilitators and other program exchanges.
3. Partner institutions agree to communicate program changes in a timely manner to avoid disruption to student progress toward degree completion.

III. PROGRAM ARTICULATION AGREEMENT

The following details a recommended course of study for students earning the Associate of Science degree in General Engineering at MC transferring to UMBC in pursuit of the Bachelor of Science degree in Mechanical Engineering. Where noted, course equivalencies, general education and major applicability are indicated.

Montgomery College Course Number	Montgomery Course Title	Montgomery Credits	UMBC Equivalency	UMBC General Education Requirement	Notes
General Requirements					
EN101	Techniques of Reading and Writing I	3	LLE		If needed for EN102, otherwise not required
EN102 or EN109	Techniques of Reading and Writing II	3	ENGL 100	EN	EN102 recommended
CH101	Principles of Chemistry I	4	CHEM 101	SL	Students must complete both CH101 and 102 at MC to receive CHEM101 and CHEM102+102L credit
PH262	Electricity and Magnetism	4	PHYS 122	SL	
MA181	Calculus	4	MATH 151	M	
Behavioral/Social Science		3	SS	SS[1]	
Behavioral/Social Science		3	SS	SS[1]	
Humanities		3	AH	AH [1]	

Health Foundation (HE100 recommended)		1	SS	SS[1]	HE100, Principles of Healthy Living, is suggested
Art		3	AH	AH[1]	
Total General Requirements		28			
Program Requirements					
CH102	Principles of Chemistry II	4	CHEM 102 +102L		Students must complete both CH101 and 102 at MC to receive CHEM101 and CHEM102+102L credit
ES100[2]	Intro to Engineering Design	3	ENES101[2]		Must complete both ES 100 and ES 240 at MC to receive credit for ENES101
ES240[2]	Scientific and Engineering Computation	3	LLE		Must complete both ES 100 and ES 240 at MC to receive credit for ENES101
MA182[2]	Calculus II	4	MATH 152[2]	M	
MA280	Multivariable Calculus	4	MATH 251		
MA282	Differential Equations	3	MATH 225		
ES102[2]	Statics	3	ENME 110[2]		
PH 161	Mechanics and Heat	3	PHYS 121	S	
ES221	Dynamics	3	ENME 221		
ES232	Thermodynamics	3	ENME 217		
Total Program Requirements		33			

Additional Required for Transfer to UMBC					
ES220	Mechanics of Materials	3	ENME 220		Not required for MC A.S.
Total for additional		3			
		61-64			
Total Number of Credits Required for *Mechanical Engineering* degree		127			
Maximum Number of Transfer Credits Applied Towards *Mechanical Engineering* degree		64			
Minimum Number of Credits Remaining for Completion of 127 Credits Required for *Mechanical Engineering* degree		63			

[1] These courses satisfy the general categories as indicated. To view specific course equivalency, consult ARTSYS (artweb.usmd.edu).

[2] Students are admitted to the Mechanical Engineering program only when they pass all four of the following Gateway courses with required grades: MATH152 (MA182), ENES101 (ES100 and ES240) and ENME110 (ES102) with a grade of "B" or better and CHEM101 (CH101), with a grade of "C" or better. Students are permitted to retake two of the gateway courses one time to earn the required grade (a withdrawal DOES account as an attempt).

Legend

AH	Arts/Humanities
C	Culture
EN	English Composition
L	Language
LLE	Lower Level Elective

M	Mathematics
PE	Physical Education
S	Science
SL	Science (plus lab)
SS	Social Sciences

Suggested Transfer Pathway
Montgomery College A.S. in General Engineering to UMBC's B.S. in Mechanical Engineering

Year One – Montgomery College

(Course sequence may vary)

Fall Semester	Cr
CH101 Principles of Chemistry I	4
ES100 Introduction to Engineering Design	3
EN101 Techniques of Reading and Writing I*	3
MA181 Calculus	4
Arts Distribution	3
Total Credits	**14-17**

Spring Semester	Cr
CH102 Principles of Chemistry II	4
EN102 Techniques of Reading and Writing II	3
MA 182 Calculus II	4
ES102 Statics	3
PH161 Mechanics and Heat	3
Total Credits	**17**

Year Two – Montgomery College

Fall Semester	Cr
ES220 Mechanics of Materials †	3
MA280 Multivariable Calculus	4
PH262 Electricity and Magnetism	4
Behavioral and Social Science Distribution ‡	3
ES240 Scientific Engineering and Computation	3
Total Credits	**17**

Spring Semester	Cr
HE100 Principles of Healthy Living	1
ES221 Dynamics	3
MA282 Differential Equations	3
ES232 Thermodynamics	3
Behavioral and Social Science Distribution ‡	3
Humanities Distribution	3
Total Credits	**16**

Apply to graduate from Montgomery College with an Associate of Science in General Engineering

* If needed for EN102, if not no substitution required.

† ES220 is not required for the A.S. but is required for the Mechanical Engineering Major at UMBC

‡ Select from two different disciplines, one course must also meet MC's Global & Cultural requirement

COMPETITIVE ADMISSION: *Students are admitted to the Mechanical Engineering program only when they pass all four of the following Gateway courses with required grades: MATH152 (MA182), ENES101 (ES100 and ES240) and ENME110 (ES102) with a grade of "B" or better and CHEM101 (CH101) with a grade of "C" or better. Students are permitted to retake two of the gateway courses one time to earn the required grade (a withdrawal DOES count as an attempt).*

Upon enrollment, UMBC will determine the transferability of any courses not taken at MC. Students should be prepared to provide syllabi, course descriptions, exams and homework as requested.

Year Three – UMBC

Fall Semester	Cr
PHIL251 Ethical Issues in Science and Engineer	3
ENME204 Intro to Engineering Design w/CAD	3
ENME301 Structure and Prop. Of Eng. Materials	3
ENME303 Topics of Engineering Math	3
ENME320 Fluid Mechanics	3
PHED course (institutional credit) Ω	0
Total Credits	**15**

Spring Semester	Cr
GEP Culture	3
ENEE302 Principles of Electrical Engineering	4
ENME321 Transfer Processes	3
ENME360 Vibrations	3
ENME332L Solid Mechanics and Materials Lab	3
Total Credits	**16**

Year Four - UMBC

Fall Semester	Cr
GEP Language , 201 Level ††	4
ENME403 Automatic Controls	3
ENME4XX Elective	3
ENME432L Fluids/Energy Lab	2
PHED course (institutional credit) Ω	0
ENME304 Machine Design	3
Total Credits	**15**

Spring Semester	Cr
S/T Elective	3
ENME482L Vibrations/Controls Lab	2
ENME4XX Design Elective	3
ENME444 Mech Engineering Systems Design	3
STAT355 Intro to Prob & Stat for Sci and Engr	4
Total Credits	**15**

Ω Two activity courses are required prior to graduation (unless 30 or older, exempted based on a qualified physical disability or a military veteran).

††Unless exempt, all UMBC students are required to complete language at 201 level, students should plan to complete language pre-requisites.

MC GENERAL ENGINEERING A.S. to UMBC B.S. in Mechanical Engineering

Total Credits: 60-67, Catalog Edition 13-14

Name:	Date:	ID#

GENERAL EDUCATION FOUNDATION & DISTRIBUTION COURSES

Foundation Courses	COURSE	HRS	GRADE
English 101*	EN101*	(3)	
English Foundation	EN102	3	
Math Foundation	MA181	4	
Health Foundation (HLHF)	HE100	1	

Distribution Courses	COURSE	HRS	GRADE
Arts Distribution (ARTD)		3	
Humanities Distribution (HUMD)		3	
Behavioral / Social Science Distribution (BSSD)‡		3	
Behavioral / Social Science Distribution (BSSD)‡		3	
Natural Sciences Distribution with Lab (NSLD)	PH262	4	
Natural Sciences Distribution with Lab (NSLD)	CH101	4	

Curriculum Requirements	COURSE	HRS	GRADE
Mechanics and Heat	PH161	3	
Introduction to Engineering Design	ES100	3	
Calculus II	MA182	4	
Multivariable Calculus	MA280	4	
Differential Equations	MA282	3	
EE or ES ELECTIVE	ES240	3	
EE, ES or Science ELECTIVE	ES221	3	
EE, ES or Science ELECTIVE	ES232	3	
EE, ES or Science ELECTIVE	ES102	3	
PH 263 or ELECTIVE	CH102	3-4	
Additional UMBC Course requirement †	ES220†	3	

Global & Cultural Perspectives Requirement:	Total Credits: 60-67

* EN101 only if needed for EN102 or EN109, no substitution required

‡ Select from two different disciplines, one course must also meet MC's Global &Cultural requirement

† ES220 is not required for the A.S. but is required for the Mechanical Engineering Major at UMBC

COMPETITIVE ADMISSION: *Students are admitted to the Mechanical Engineering program only when they pass all four of the following Gateway courses with required grades: MATH152 (MA182), ENES101 (ES100 and ES240) and ENME110 (ES102) with a grade of "B" or better and CHEM101 (CH101) with a grade of "C" or better. Students are permitted to retake two of the gateway courses one time to earn the required grade (a withdrawal DOES count as an attempt).*

Upon enrollment, UMBC will determine the transferability of any courses not taken at MC. Students should be prepared to provide syllabi, course descriptions, exams and homework as requested.